

# Records of Tubificid Oligochaetes from Padang, West Sumatra, Indonesia, with Description of a New Species of *Aulodrilus* Bretscher

Akifumi Ohtaka<sup>1</sup> and Rustam Usman<sup>2</sup>

<sup>1</sup>Department of Natural Science, Faculty of Education,  
Hirosaki University, Hirosaki 036, Japan

<sup>2</sup>Department of Biology, Faculty of Science, Andalas University,  
Kampus Limau Manis, Padang, 25163, Indonesia

(Received 31 March 1997; Accepted 13 June 1997)

A new tubificid oligochaete, *Aulodrilus acutus*, is described from Padang, West Sumatra, Indonesia. It resembles *Aulodrilus pigueti* Kowalewski by sharing oar-shaped chaetae, globular atria, and a median male bursa, but is distinguished by having tapering distal ends to the oar-shaped chaetae and by lacking penial chaetae and the associated glands. *Aulodrilus pigueti* and *Teneridrilus* sp. are also described. *Branchiura sowerbyi* and *Limnodrilus hoffmeisteri* are recorded from Sumatra.

**Key Words:** Oligochaeta, Tubificidae, Taxonomy, Sumatra, Indonesia, *Aulodrilus*, Chaetae.

## Introduction

According to the zoogeographical division of inland waters by Timm (1980), the Greater Sunda Islands including Sumatra belong to the Indo-Malayan subregion of the Sino-Indian region. In this subregion, faunistic and taxonomic investigations of aquatic oligochaetes have previously focused on material mainly from India and the neighboring areas, but the Greater Sunda Islands are still poorly explored. As regards the family Tubificidae, only two species (*Limnodrilus socialis* Stephenson and *Aulodrilus trivandranus* Aiyer) have previously been recorded from the islands (Michaelsen and Boldt 1932), on the basis of material collected by the German Limnological Sunda Expedition in 1928-1929.

In this paper we record and describe five tubificid oligochaete species from Padang, West Sumatra, which is close to the equator. The material was collected from paddy fields during a short visit by the senior author. Specimens were immediately fixed in 10 % formalin solution. Later, they were observed and illustrated under a light microscope after they had been mounted whole in either polyvinyl lactophenol or Canada Balsam. Anatomical observations were made on dissected specimens and specimens cut serially (sections 8-10  $\mu$ m thick) and stained with haematoxylin and eosin. In addition, a detailed observation of chaetal structure was made by scanning electron microscopy. The type series is deposited in the Division of Biological Sciences, Graduate School of Science, Hokkaido University (ZIHU).

Family **Tubificidae**  
 Subfamily **Rhyacodrilinae**  
 Genus ***Branchiura*** Beddard  
***Branchiura sowerbyi*** Beddard, 1892

*Branchiura sowerbyi* Beddard, 1892, p. 325, pl. XIX, figs 1-15.

*Branchiura sowerbyi* Beddard: Stephenson, 1912, p. 286, figs 1-8; Brinkhurst, 1971, p. 563, fig. 8.36D-F.

**Material examined.** 43 immature individuals, Tabing, Padang, 3 Aug. 1988; 18 immature individuals, Aru Indah, Padang, 4 Aug. 1988.

**Remarks.** This species commonly occurred in the paddy fields surveyed.

Subfamily **Tubificinae**  
 Genus ***Limnodrilus*** Claparède  
***Limnodrilus hoffmeisteri*** Claparède, 1862

*Limnodrilus hoffmeisteri* Claparède, 1862, Mém. Soc. Phys. Hist. nat. Genève 16, p. 226, pl. I, figs 1-3, pl. III, fig. 12, pl. IV, fig. 6.

*Limnodrilus hoffmeisteri* Claparède: Brinkhurst, 1971, p. 464, figs 8.3M, O, 8.4C, H, I, 8.5E.

*Limnodrilus socialis* Stephenson, 1912, p. 294, figs 9-16.

*Limnodrilus gotoi* Hatai (emend.): Nomura, 1913, p. 3, figs 1-24.

*Limnodrilus pacificus* Chen, 1940, p. 118, figs 33-34.

**Material examined.** Five mature individuals, Aru Indah, Padang, 4 Aug. 1988.

**Remarks.** The specimens examined were all of the typical "plate-topped" form (Brinkhurst 1971). Michaelsen and Boldt (1932) recorded this species from Java under the name *L. socialis*.

Genus ***Aulodrilus*** Bretscher  
***Aulodrilus pigueti*** Kowalewski, 1914  
 (Figs 1-2)

*Aulodrilus pigueti* Kowalewski, 1914, Bull. int. Acad. Sci. Lett. Cracovie 54, p. 25, fig. 12.

*Aulodrilus pigueti* Kowalewski: Hrabě, 1981, p. 72, pl. 11, figs 16-21, pl. 12, figs 1-6; Brinkhurst *et al.*, 1990, p. 908, fig. 2A; Finogenova and Arkhipova, 1994, p. 13, figs 14-17.

*Aulodrilus remex* Stephenson, 1921, p. 753, pl. XXVIII, figs 2-6; 1923, p. 107, figs 42-45; Aiyer, 1929, p. 81, pl. VI, figs 1-10; Naidu, 1965, p. 470, fig. 3a-e.

*Aulodrilus kashi* Mehra, 1922, p. 946, figs 1-11; Stephenson, 1923, p. 509.

*Aulodrilus prothecatus* Chen, 1940, p. 68, fig. 22.

*Aulodrilus tchadensis* Lauzanne, 1968, p. 99, figs 12, 13.

**Material examined.** Seven mature and five immature individuals, Tabing, Padang, 3 Aug. 1988; three mature individuals, Aru Indah, Padang, 4 Aug. 1988.

**Description.** In mature and fixed state, body 10-18 mm long, 0.3-0.4 mm wide in anterior segments. Clitellar segments thick and ventrally flattened. Posterior end of body unsegmented and without chaetae. Prostomium blunt. Dorsal hair chaetae

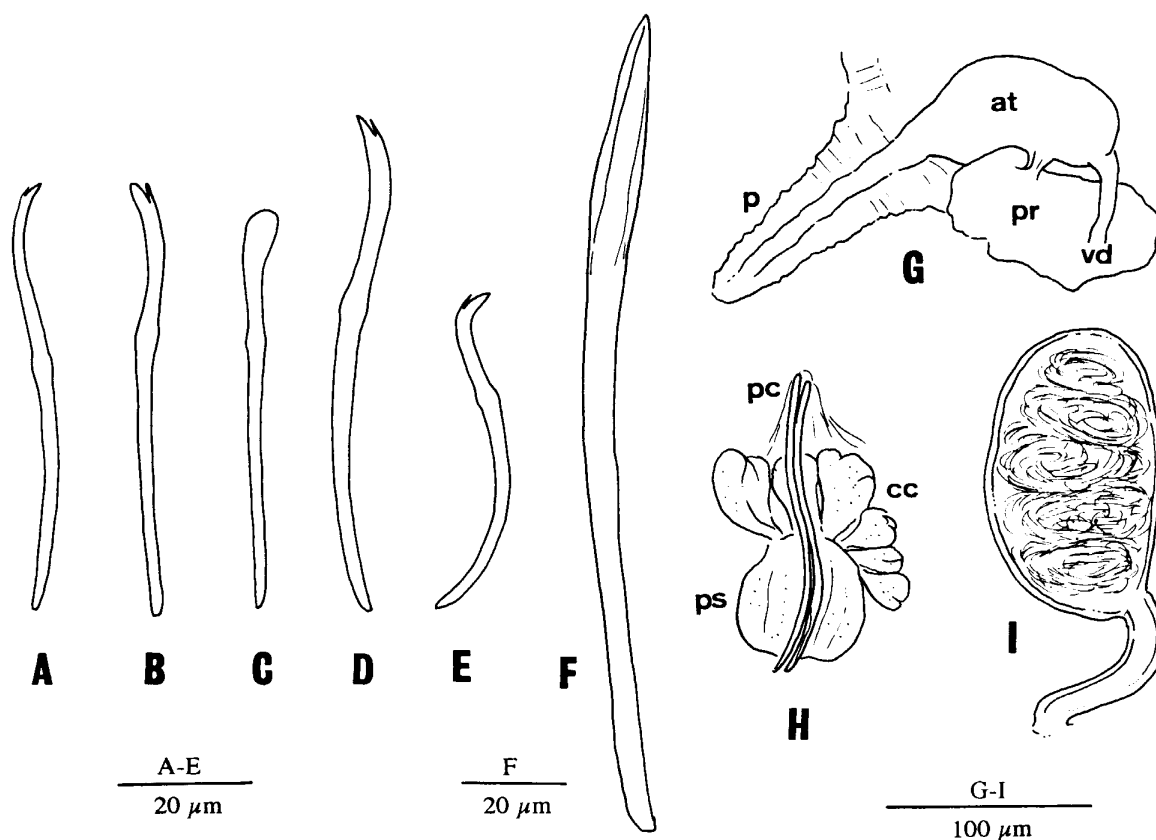


Fig. 1. Chaetae and genital organs in *Aulodrilus pigueti* from Padang, Sumatra. A, dorsal chaeta in II; B, the same in X; C, the same in a middle segment; D, ventral chaeta in IV; E, the same in a posterior segment; F, penial chaeta; G, male duct; H, penial chaetal sac; I, spermatheca. at, atrium; cc, cap cell; p, penis; pc, penial chaeta; pr, prostate gland; vd, vas deferens.

beginning from III or IV or V, bayonet-shaped, 1-6 per bundle, 84-102  $\mu\text{m}$  long in anterior segments, 1-3 per bundle in middle and posterior segments. Dorsal bifurcate chaetae in anterior segments (Fig. 1A) 3-7 per bundle, 60-80  $\mu\text{m}$  long, with upper tooth shorter and much thinner than lower. Oar-shaped chaetae replacing bifurcate chaetae from VII-X (Fig. 1B, C), 1-5 per bundle, 52-70  $\mu\text{m}$  long; distal end roundly expanded and hollow with a rim on margin (Fig. 2A, B). Ventral chaetae (Fig. 1D, E) all bifurcate, 3-9 per bundle, 60-76  $\mu\text{m}$  long in anterior segments, 3-5 per bundle, 40-56  $\mu\text{m}$  long in posterior ones; upper tooth shorter and much thinner than lower (Fig. 2C). Straight or sigmoid large penial chaetae (Fig. 1F) in VII, 2 per bundle, 150-200  $\mu\text{m}$  long, with distal end hollow and spoon-shaped.

Clitellum from 1/2 VI to end of VIII. Two pairs of testes in V and VI, one pair of ovaries in VII. Male funnels on anterior face of 6/7, about 40  $\mu\text{m}$  in diameter. Vasa deferentia winding, entering atria apically. Atria ovoid, 100  $\mu\text{m}$  long by 50  $\mu\text{m}$  (Fig. 1G); inner epithelium tall and glandular. Prostate glands almost as large as atria, connected to atria laterally through short stalks. Penes large and conical, 120  $\mu\text{m}$  long when protruded (Fig. 2D), opening at median male bursa in VII (Fig. 2E). Penial chaetae set in spherical chaetal sacs, 60-70  $\mu\text{m}$  in diameter, composed of tall and glandular simple epithelium and thin peritoneal covering (Figs 1H, 2F). Penial chaetal sacs situated just behind male pores in male bursa. Large glandular cap cells

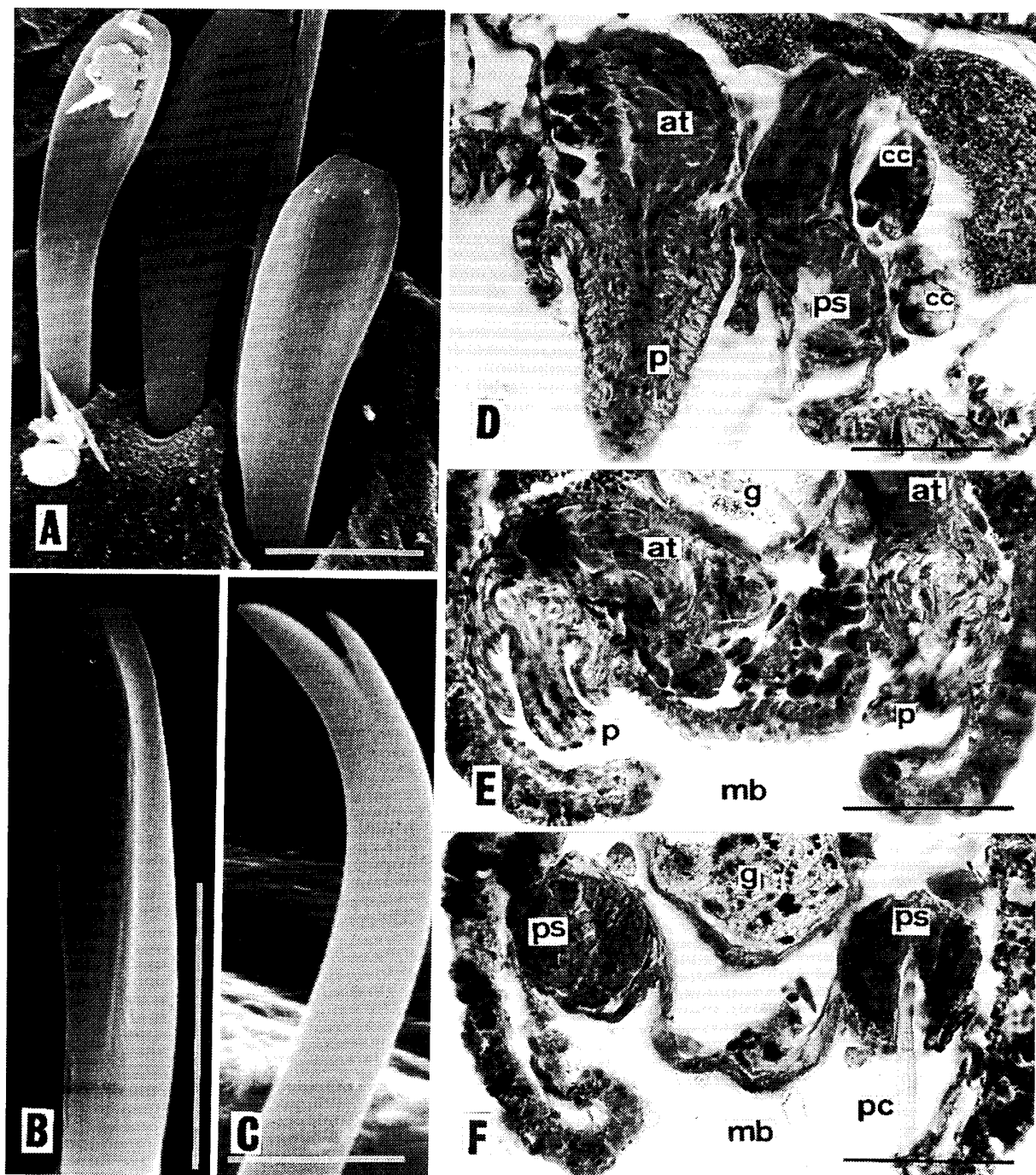


Fig. 2. Chaetae and genital organs in *Aulodrilus pigueti* from Padang, Sumatra. A, distal ends of oar-shaped chaetae in an anterior segment, frontal view; B, one of the same, lateral view; C, distal end of ventral chaeta in an anterior segment; D, sagittal section in terminal part of male duct together with a penial chaetal sac; E, cross section of median male bursa at the level of the male pores; F, the same at the level of the penial chaetal sac. g, gut; mb, median male bursa; ps, penial chaetal sac; other abbreviations as in Fig. 1. Scales: A-C, 5  $\mu$ m; D-F, 50  $\mu$ m.

attached in several clusters on chaetal sacs apically (Fig. 1H). Spermathecae (Fig. 1I) in VI; ampullae ovoid, 140-150  $\mu\text{m}$  long by 100  $\mu\text{m}$ , ducts long and well marked off from ampullae, opening in front of chaetal bundles in VII ventrolaterally. Some to several loose sperm masses found in spermathecal ampullae in mated specimens. Worm forming a mud tube.

**Remarks.** The present material agrees well with previous descriptions of *A. pigueti* by Brinkhurst (1971) and Brinkhurst *et al.* (1990), *A. remex* by Stephenson (1921, 1923), Aiyer (1929) and Naidu (1965), *A. kashi* by Mehra (1922) and Stephenson (1923), *A. prothecatus* by Chen (1940), and *A. tchadensis* by Lauzanne (1968), in having rounded oar-shaped chaetae in dorsal bundles, spherical or bean-shaped atria, a median male bursa, and spoon-shaped penial chaetae with glandular chaetal sacs. The length of each kind of chaeta in the present species also agrees with those in descriptions of the species compared above. We regard all of above species as synonyms as partly indicated by Chekanovskaya (1962), Brinkhurst (1963, 1971), Brinkhurst *et al.* (1990), and Finogenova and Arkhipova (1994). Although Finogenova and Arkhipova (1994) regarded *A. prothecatus* as a separate species because the spermathecal pores are located anterior to those in *A. pigueti*, such a characteristic is known to vary intraspecifically (Brinkhurst 1971) and thus can not be used as a specific character. Simple-pointed chaetae have been described in the anterior dorsal bundles by Stephenson (1921, 1923; for *A. remex*) and Naidu (1965; for *A. remex*) and by Brinkhurst *et al.* (1990). The distal tooth of the dorsal crotchets is often very small in the present material, so it was probably overlooked by the previous authors.

The South American *Aulodrilus cernosvitovi* Marcus, 1947 is another form having oar-shaped chaetae in dorsal bundles as in *A. pigueti* (Marcus 1947). Brinkhurst (1971) once synonymized it with *A. pigueti*, and Howmiller (1974) suggested that *A. pigueti* and *A. cernosvitovi* should be regarded as subspecies, because of their allopatric distribution in addition to differences in chaetal morphology. However, *A. cernosvitovi* largely differs from *A. pigueti* not only in chaetae but also in genital organs as follows: the atrium is tubular and the male pore opens independently in *A. cernosvitovi*, while the atrium is spherical or bean-shaped and the two male ducts terminate in a common median male bursa in *A. pigueti*; the ventral chaetae of the atrial segment are not modified in *A. cernosvitovi*, whereas they are modified as large penial chaetae in *A. pigueti*. In addition, a strong midrib on the oar-shaped chaetae, which was redescribed by Howmiller (1974), is unique to *A. cernosvitovi*. Each of these characteristics is specifically important, and thus *A. cernosvitovi* should be regarded as a distinct species. Brinkhurst and Marchese (1987) described no modified penial chaetae and figured the midribbed oar-shaped chaetae in South American specimens under the name *A. pigueti*. They suggested that several supposed synonyms required revision based on new Asian material. Their specimens can be ascribed to *A. cernosvitovi*.

### *Aulodrilus acutus* sp. n.

(Figs 3-4)

**Material examined.** Holotype: ZIHU-1077, one whole-mounted mature individual, Tabing, Padang, 3 Aug. 1988. Paratypes: ZIHU-1078, 1079, one sagittally sectioned and one cross-sectioned individual, collection data same as for holotype.

Other material: 12 mature and five immature individuals, collection data same as for holotype; three mature individuals, Aru Indah, Padang, 4 Aug. 1988.

**Description.** In mature and fixed state, body up to 30 mm long, up to 0.45 mm wide in anterior segments. Clitellar segments thick and flattened ventrally. Hind end of body unsegmented. Prostomium bluntly conical. Dorsal chaetal bundles composed of short hairs and bifurcate or oar-shaped chaetae. Dorsal hair chaetae smooth and bayonet-shaped, beginning in VI or VII, 1-9 per bundle, 130-156  $\mu\text{m}$  long; hair chaetae fewer (mostly 1 or 2) in the first segment bearing them than in the following segments. Dorsal crotchets in several anterior segments (Fig. 3A), 5-8 per bundle, 96-120  $\mu\text{m}$  long, with distal nodulus and with parallel teeth; upper tooth about half as long as and much thinner than lower (Fig. 4A); from VI-VIII posterior, bifid chaetae gradually replaced by oar-shaped chaetae with distal nodulus and tapering and pointed distal end (Figs 3B-D, 4B). Ventral chaetae all bifid crotchets; in anterior segments (Fig. 3E) 5-14 per bundle, 84-126  $\mu\text{m}$  long, with distal nodulus and upper tooth shorter and much thinner than lower (Fig. 4C); in middle and posterior segments, ventral chaetae (Fig. 3F) 6-12 per bundle, 80-100  $\mu\text{m}$  long, more strongly curved with nodulus more distal than in anterior segments. Ventral chaetae of atrial segment lost in fully mature individuals.

Clitellum from 1/2VI to end of VIII. Paired testes in V and VI, former pair smaller than latter. Paired ovaries and male ducts (Fig. 3G) in VII. Male funnels small, about

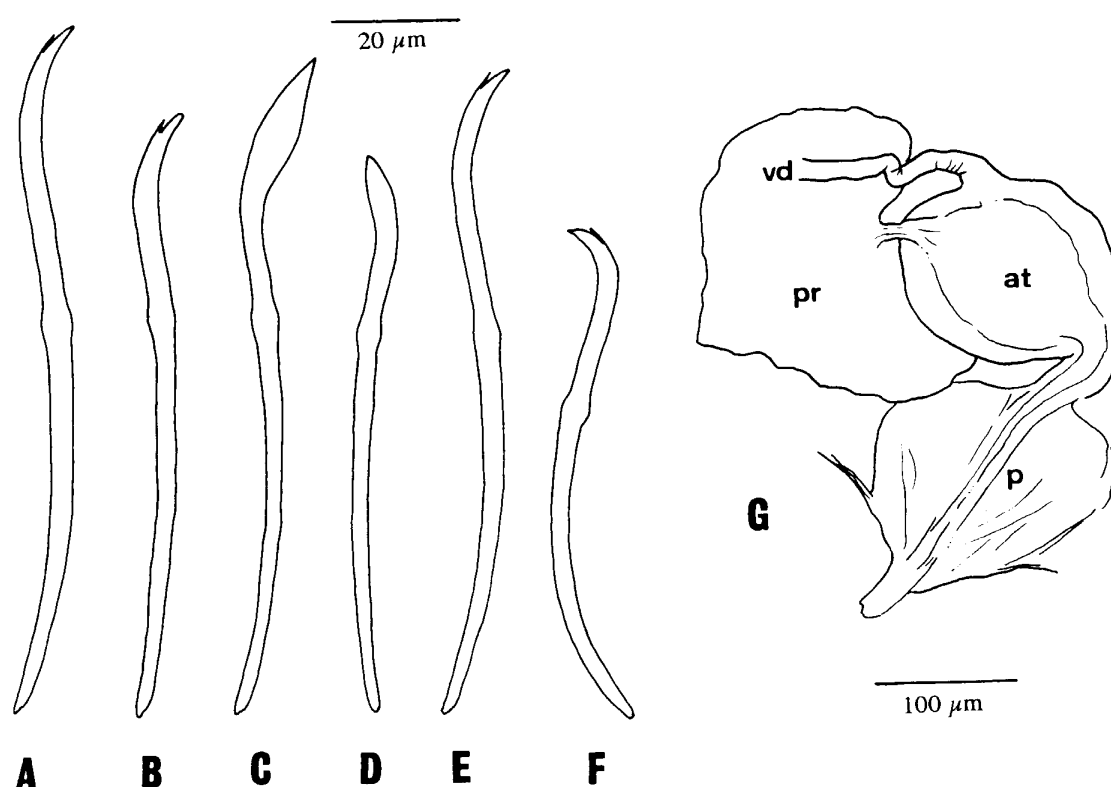


Fig. 3. Chaetae and genital organs in *Aulodrilus acutus* sp. n. from Padang, Sumatra. A, dorsal chaeta in V; B and C, the same in VIII; D, the same in a middle segment; E, ventral chaeta in V; F, the same in a middle segment; G, male duct. Abbreviations as in Fig. 1.

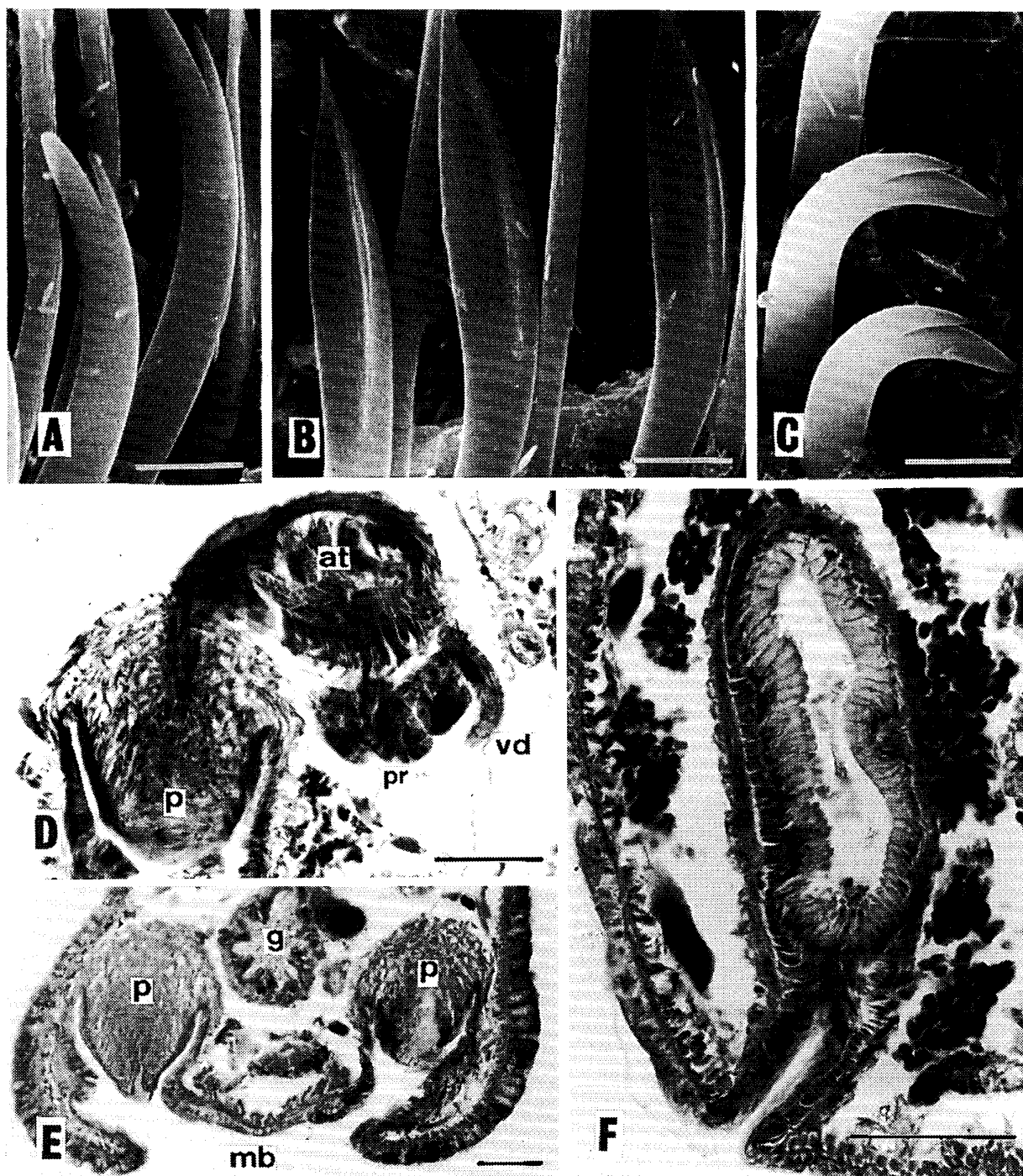


Fig. 4. Chaetae and genital organs in *Aulodrilus acutus* sp. n. from Padang, Sumatra. A, distal ends of dorsal chaetae in V; B, the same in a middle segment; C, distal ends of ventral chaetae in an anterior segment; D, sagittal section in terminal part of male duct; E, cross section of median male bursa at the level of the male pores; F, sagittal section of spermatheca. Abbreviations as in Figs 1-2. Scales: A-C, 5  $\mu$ m; D-F, 50  $\mu$ m.

56  $\mu$ m in diameter. Vasa deferentia about 100  $\mu$ m long, short, stout and hardly winding, connected with atria subapically. Atria globular, 140  $\mu$ m in diameter, with thick muscular covering (Fig. 4D). Prostate glands larger than atria, connected with

atria apically through short stalks. Ejaculatory ducts short ( $40\text{ }\mu\text{m}$  long) and stout. Penes large and conical, opening into large, median, ventral male bursa at middle of VII (Fig. 4E). Spermathecae in VI, opening ventrally in anterior part of VI; ducts about  $50\text{ }\mu\text{m}$  long, short and weakly marked off from ampullae, ampullae tubular,  $200\text{--}350\text{ }\mu\text{m}$  long, with tall inner epithelium and thick muscular covering (Fig. 4F). Sperm diffused in spermathecal ampullae. Worm forming a tight mud tube.

**Remarks.** In one of the 12 mature specimens examined, the position of the genital organs was shifted more anteriorly; the clitellum was in III-V, the spermathecae in III and the male ducts in IV, but the shape of these organs was normal. In this specimen, the dorsal hair chaetae were distributed from III, being shifted more anteriorly than in other specimens.

The present species appears closely related to *Aulodrilus pigueti*, sharing oar-shaped chaetae, globular atria, and a median male bursa with the latter. However, there are several distinct differences between them as follows: the oar-shaped chaetae are acute distally in the present species (Figs 3C, D, 4B), while rounded in *A. pigueti* (Figs 1C, 2A, B); large penial chaetae set in glandular chaetal sacs are present in *A. pigueti* (Figs 1H, 2F), while such chaetae and their associated organs are wholly absent in the present species; the spermathecal ampullae are ovoid in *A. pigueti*, while they are tubular in the present species. In addition, the dorsal hair chaetae of *A. pigueti* have been found from III (Brinkhurst *et al.* 1990; present study) or IV (Mehra 1922, for *A. kashi*; Chen 1940, for *A. prothecatus*; Lauzanne 1968, for *A. tchadensis*; Finogenova and Arkhipova 1994), while the corresponding chaetae begin to appear from some more posterior segment (VI or VII) in the present species. The present species was collected together with *A. pigueti*. As far as mature individual are concerned, the body of *A. acutus* is larger, and each kind of chaeta is also distinctly longer than in *A. pigueti*.

#### Genus *Teneridrilus* Holmquist

##### *Teneridrilus* sp.

(Fig. 5)

**Material examined.** One incomplete mature individual, Tabing, Padang, 3 Aug. 1988.

**Description.** In fixed state, body  $11\text{mm}+$  long. Posterior part of body slender with elongate segments. Coelomocytes absent. Prostomium small. Mouth large and pursed up in fixed state (Fig. 5A). Pharynx in II and III, large and folded. Gut becoming wider from VIII. Dorsal chaetae of II (Fig. 5B) and III bifurcated with nodulus distally, 3 per bundle, with upper tooth a little longer and thinner than lower. From IV on, dorsal chaetal bundles composed of 1-3 short ( $80\text{--}110\text{ }\mu\text{m}$  long), bayonet-shaped hair chaetae and 2-4 bifurcate crotchets (Fig. 5C) with distal nodulus and with upper tooth longer and thinner than lower. Ventral chaetae (Fig. 5D) all bifurcate with distal nodulus, 2-5 per bundle, with upper tooth a little longer and thinner than lower. Clitellum from beginning of XI to end of XIII. Ovaries large and developed in XI, while male ducts and spermathecae not detected.

**Remarks.** This specimen can be assigned to the genus *Teneridrilus* Holmquist by having a large mouth and a large and folded pharynx. It closely resembles *T. mastix* (Brinkhurst) in having hair and simply bifid chaetae in the dorsal bundles. The absence of male ducts and spermathecae noted for the present material was also



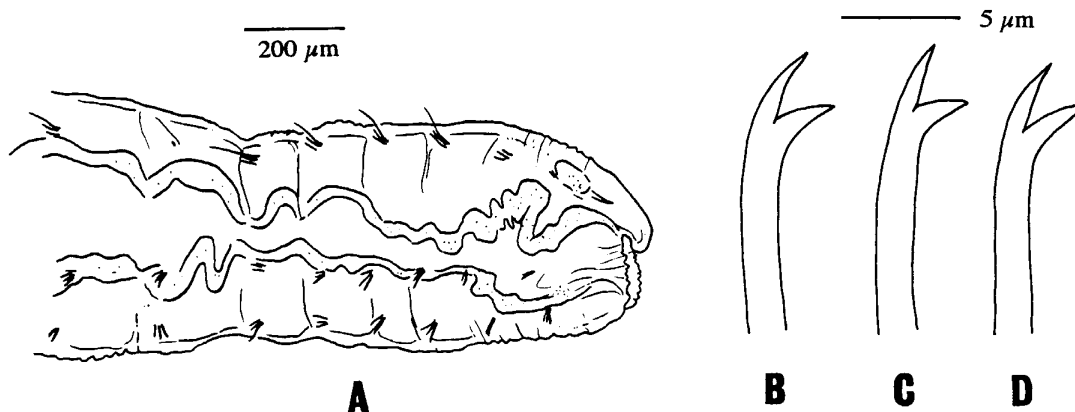


Fig. 5. *Teneridrilus* sp. from Padang, Sumatra. A, anterior part of body; B, distal end of dorsal chaeta in II; C, the same in a posterior segment; D, distal end of ventral chaeta in III.

described for Chinese *T. mastix* by Erséus and Qi (1985). However, the present specimen has three chaetae in II and III both dorsally and ventrally, thereby being different from the original description of *T. mastix* by Brinkhurst (1978), in which the dorsal and ventral chaetae in II are reported as usually single, and the chaetae of III as often missing. In addition, although Erséus *et al.* (1990) recognized modification of chaetae in II as a synapomorphy for the genus, such a modification was not found in the present individual. The variability in number and form of chaetae in the congeners needs to be established to clarify the taxonomic situation of the present specimen and to establish the diagnosis of *Teneridrilus*.

### Acknowledgments

We would like to thank Dr. R. O. Brinkhurst (Aquatic Resources Center, TN, USA) for his critical reading of the manuscript. Cordial thanks are also due to Dr. A. Bakar and Prof. S. Salmah (Andalas University, Indonesia), and Prof. S. Nakano (Hiroshima Shudo University, Japan) for providing facilities for the survey and guidance in the field.

### References

- Aiyer, K. S. P. 1929. On the sexual organs of the tubificid worm *Aulodrilus remex* Steph. Records of the Indian Museum 31: 81-85.
- Beddard, F. E. 1892. A new branchiate Oligochaeta (*Branchiura sowerbyi*). Quarterly Journal of Microscopic Science 33: 325-341.
- Brinkhurst, R. O. 1963. Taxonomical studies on the Tubificidae (Annelida, Oligochaeta). Internationale Revue der Gesamten Hydrobiologie. Systematisch Beiheft 2: 1-89.
- Brinkhurst, R. O. 1971. Part 2. Systematics, 8. Family Tubificidae, Pp. 444-625. In: Brinkhurst, R. O. and Jamieson, B. G. M. (Eds.) *Aquatic Oligochaeta of the World*. Oliver and Boyd. Edinburgh, 860pp.
- Brinkhurst, R. O. 1978. Freshwater Oligochaeta in Canada. Canadian Journal of Zoology 56:

- 2166-2175.
- Brinkhurst, R. O. and Marchese, M. 1987. A contribution to the taxonomy of the aquatic Oligochaeta (Haplotaxidae, Phreodrilidae, Tubificidae) of South America. *Canadian Journal of Zoology* 65: 3154-3165.
- Brinkhurst, R. O., Qi, S. and Liang, Y. 1990. The aquatic Oligochaeta from the People's Republic of China. *Canadian Journal of Zoology* 68: 901-916.
- Chekanovskaya, O.V. 1962. Aquatic Oligochaeta of the U.S.S.R. *In* : Pavlovskii, E. N. (Ed.) *Key to the Fauna of the U.S.S.R.* Institute of Zoology. Academy of Sciences, Moscow.
- Chen, Y. 1940. Taxonomy and faunal relations of the limnic Oligochaeta of China. *Contributions from the Biological Laboratory of the Science Society of China, Zoological Series* 14: 1-131.
- Erséus, C. and Qi, S. 1985. Two aberrant Tubificidae (Oligochaeta) from Pearl River in the People's Republic of China. *Hydrobiologia* 127: 193-196.
- Erséus, C., Hiltunen, J. K. Brinkhurst, R. O. and Schloesser, D. W. 1990. Redefinition of *Teneridrilus* Holmquist (Oligochaeta: Tubificidae), with description of two new species from North America. *Proceedings of the Biological Society of Washington* 103: 839-846.
- Finogenova, N. P. and Arkhipova, N. R. 1994. Morphology of some species of the genus *Aulodrilus* Bretscher. *Hydrobiologia* 278: 7-15.
- Howmiller, R. P. 1974. Some Naididae and Tubificidae from Central America. *Hydrobiologia* 44: 1-12.
- Hrabě, S. 1981. The freshwater Oligochaeta (Annelida) of Czechoslovakia. *Acta Universitatis Carolinae, Biologica* 1979: 1-167. (In Czech with English summary)
- Lauzanne, L. 1968. Inventaire préliminaire des Oligochètes du Lac Tchad. *Cahiers O.R.S.T.O.M. série Hydrobiologie* 11: 83-110.
- Marcus, E. du B.-R. 1947. Naidids and tubificids from Brazil. *Comunicaciones Zoológicas del Museo de Historia Natural de Montevideo* 2 (44): 1-18.
- Mehra, H. R. 1922. Two new Indian species of the little-known genus *Aulodrilus* Bretscher of the aquatic Oligochaeta belonging to the family Tubificidae. *Proceedings of the Zoological Society of London* 59: 943-969.
- Michaelsen, W. and Boldt, W. 1932. Oligochaeta der Deutschen Limnologischen Sunda-Expedition. *Archiv für Hydrobiologie. Supplement* 9: 587-622.
- Naidu, K. V. 1965. Studies on the fresh-water Oligochaeta of south India. II. Tubificidae. *Hydrobiologia* 26: 463-483.
- Nomura, E. 1913. On two species of aquatic Oligochaeta, *Limnodrilus gotoi* Hatai and *L. willeyi*, n. sp. *Journal of the College of Science, Tokyo Imperial University* 35: 1-49.
- Stephenson, J. 1912. On *Branchiura sowerbyi* Beddard, and new species of *Limnodrilus* with distinctive characters. *Transactions of the Royal Society of Edinburgh* 48: 294-305.
- Stephenson, J. 1921. Oligochaeta from Manipur, the Laccadive Islands, Mysore, and other parts of India. *Records of the Indian Museum* 22: 745-768.
- Stephenson, J. 1923. Oligochaeta, Family Tubificidae. Pp. 95-108, 509-510. *In*: Shipley, A. E. and Scott, H. (Eds.) *The Fauna of British India, Including Ceylon and Burma*. Taylor and Francis, London, 518pp.
- Timm, T. 1980. Distribution of aquatic oligochaetes. Pp. 55-77. *In*: Brinkhurst, R. O. and Cook, D. G. (Eds.) *Aquatic Oligochaete Biology*. Plenum, New York, 529pp.